

Amendment and Response

Applicant: Alvin Leng Sun Loke et al.

Serial No.: 10/717,834

Filed: November 20, 2003

Docket No.: 10031043-1

Title: SELF-TUNING VARACTOR SYSTEM

IN THE CLAIMS

Please amend claims 1, 4, 15, 20, and 21 as follows:

1. (Currently Amended) A system comprising:

a principal varactor including a set of substantially equal voltage-tunable capacitor cells, each having a capacitive range that varies with a first plurality of operating parameters and each providing a capacitance within the range based on a voltage level of a reference voltage; and

a voltage generator configured to provide the reference voltage, wherein the voltage level of the reference voltage corresponds to a desired capacitance within each of the capacitive ~~rangeranges~~ and varies based on a second plurality of operating parameters which are substantially the same as the first plurality of operating parameters, and wherein the voltage level of the reference voltage causes each capacitor cell to provide substantially the desired capacitance.

2. (Original) The system of claim 1, wherein the varactor and the voltage generator are located proximate to one another on a substrate.

3. (Original) The system of claim 2, wherein the substrate is silicon.

4. (Currently Amended) The system of claim 1, wherein the desired capacitance is substantially equal to a midpoint of each of the capacitive ~~rangeranges~~.

5. (Original) The system of claim 1, wherein a net capacitance of the principal varactor is substantially equal to a sum of the capacitances of the individual capacitor cells of the plurality.

6. (Original) The system of claim 1, wherein the voltage generator further comprises:

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a phase-locked loop (PLL) configured to provide the reference voltage, wherein the voltage level of the reference voltage varies based on the reference frequency.

7. (Original) The system of claim 6, wherein the reference VCO further includes a reference varactor comprising:

a first set of voltage-tunable capacitor cells, each substantially equal to the voltage-tunable capacitor cells of the principal varactor and receiving a first control voltage having a level causing each capacitor cell to provide a capacitance substantially equal to a minimum capacitance of the capacitive range; and

a second set of voltage-tunable capacitor cells, each substantially equal to the voltage-tunable capacitor cells of the principal varactor and receiving a second control voltage having a level causing each capacitor cell to provide a capacitance substantially equal to a maximum capacitance of the capacitive range, wherein the capacitive ranges of each voltage-tunable capacitor cell of the first and second sets of voltage-tunable capacitors cells vary based on the second plurality of operating parameters.

8. (Original) The system of claim 7, wherein the first and second sets of voltage-tunable capacitor cells comprise an equal number of capacitor cells such that a net capacitance of the reference varactor has a net capacitive value substantially equal to a midpoint capacitive value of a net capacitive tuning range of the reference varactor.

9. (Original) The system of claim 8, wherein in response to the reference varactor having a net capacitive value substantially equal to the midpoint of its net capacitive tuning range, the reference VCO generates a reference frequency corresponding to a midpoint capacitive value of the capacitive range of each capacitive cell of the first and second sets of the reference varactor and of each capacitive cell of the set of capacitive cells of the principal varactor.

10. (Original) The system of claim 7, wherein the PLL further comprises:

an auxiliary VCO configured to provide a feedback frequency based on the reference voltage;

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a phase detector configured to provide a control voltage corresponding to a phase difference between the reference frequency and the feedback frequency; and

a loop filter configured to filter the control voltage to provide the reference voltage.

11. (Original) The system of claim 10, wherein the auxiliary VCO further includes an auxiliary varactor, the auxiliary varactor comprising:

a set of voltage-tunable capacitor cells, each substantially equal to the voltage-tunable capacitor cells of the principal varactor, and having a capacitive range that varies based on a third plurality of operating parameters substantially the same as the second plurality of operating parameters, wherein each of the voltage-tunable capacitor cells of the auxiliary varactor provides a capacitance based on the voltage level of the reference voltage.

12. (Original) The system of claim 11, wherein a number of capacitive cells comprising the set of capacitive cells of the auxiliary VCO is equal to a sum of a number of cells comprising the first and second sets of the reference VCO.

13. (Original) The system of claim 10, wherein the PLL further comprises:

a first frequency divider positioned between the auxiliary VCO and the phase detector and configured to divide the feedback frequency by a divider value; and

a second frequency divider substantially the same as the first frequency divider positioned between the reference VCO and the phase detector and configured to divide the reference frequency by the divider value.

14. (Original) The system of claim 1, further comprising:

a phase-locked loop including a voltage-controlled oscillator (VCO), wherein the varactor comprises a tuning element of the VCO.

15. (Currently Amended) A voltage generator for a principal varactor including a plurality of substantially equal voltage-tunable capacitor cells, each having a capacitive range that varies based on a first plurality of operating parameters and each providing a capacitance within the range based on a reference voltage, the voltage generator comprising:

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a voltage-controlled oscillator (VCO) configured to provide a reference frequency corresponding to a desired capacitance within each of the capacitive ranges, wherein the reference frequency varies based on a second plurality of operating parameters which are substantially the same as the first plurality of operating parameters; and

a phase-locked loop (PLL) configured to provide the reference voltage, wherein the reference voltage varies based on the reference frequency and causes each capacitor cell to provide substantially the desired capacitance.

16. (Original) The voltage generator of claim 15, wherein the VCO further comprises: a reference varactor having a plurality of voltage-tunable capacitor cells, each capacitor cell being substantially the same as the voltage-tunable capacitor cells of the principal varactor.

17. (Original) The voltage generator of claim 16, wherein the PLL further includes an auxiliary VCO, the auxiliary VCO comprising:

a reference varactor having a plurality of voltage-tunable capacitor cells, each capacitor cell being substantially the same as the voltage-tunable capacitor cells of the principal varactor.

18. (Original) The voltage generator of claim 17, wherein a net capacitance of the reference varactor is substantially equal to a net capacitance of the auxiliary varactor.

19. (Original) The voltage generator of claim 15, wherein the principal varactor, the voltage-controlled oscillator, and the phase-locked loop are located proximate to one another on a substrate so as to experience a substantially same plurality of operating parameters.

20. (Currently Amended) A voltage generator for a varactor including a plurality of substantially equal voltage-tunable capacitor cells, each having a capacitive range that varies based on a first plurality of operating parameters and each providing a capacitance within the range based on a reference voltage, the voltage generator comprising:

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a voltage controlled oscillator configured to provide a reference frequency corresponding to a desired capacitance within each of the capacitive ranges; and a phase-locked loop configured to provide the reference voltage, wherein the reference voltage varies based on the reference frequency and based on a second plurality of operating parameters which are substantially the same as the first plurality of operating parameters and causes each capacitor cell to provide substantially the desired capacitance.

21. (Currently Amended) A method of operating a first varactor including a plurality of substantially equal voltage-tunable capacitor cells, each having a capacitive range that varies with a first plurality of operating parameters and each providing a capacitance within the capacitive range based on a reference voltage, the method comprising:

providing a reference frequency corresponding to a desired capacitance within each of the capacitive ranges, wherein the reference frequency varies based on a second plurality of operating parameters substantially equal to the first plurality of operating parameters; and

providing the reference voltage, wherein the reference voltage varies based on the reference ~~voltage~~frequency and causes each capacitor cell to provide substantially the desired capacitance.

22. (Original) The method of claim 21, wherein providing the reference frequency further comprises:

providing a reference voltage-controlled oscillator (VCO) having a reference varactor including a first set of voltage-tunable capacitor cells and a second set of voltage-tunable capacitor cells, wherein the capacitor cells of the first and second sets are substantially the same as the voltage-tunable capacitor cells of the first varactor and have capacitive ranges that vary based on the second plurality of operating parameters, and wherein the reference VCO provides the reference frequency based on the capacitance fo the first and second sets of voltage-tunable capacitor cells.

23. (Original) The method of claim 22, wherein providing the reference frequency further comprises:

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providing the first and second sets with an equal number of voltage-tunable capacitor cells;

driving the first set of voltage tunable capacitor cells such that each capacitor cell provides a capacitance substantially equal to a minimum capacitance of its capacitive range;

driving the second set of voltage tunable capacitor cells such that each capacitor cell provides a capacitance substantially equal to a maximum capacitance of its capacitive range.

24. (Original) The method of claim 22, wherein providing the reference voltage further comprises:

providing the reference frequency to a phase-locked loop (PLL) including an auxiliary VCO having an auxiliary varactor, wherein the auxiliary varactor comprises a set of voltage-tunable capacitor cells substantially the same as the voltage-tunable capacitor cells of the first varactor, and wherein a net capacitance of the auxiliary varactor is substantially equal to a net capacitance to the reference varactor; and

providing the reference voltage from an output of a loop filter of the PLL.

25. (Original) The method of claim 24, further comprising:

locating the first varactor, the reference VCO, and the PLL in proximity to one another on a monolithic substrate.